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(54) Open backed pedicle screw.

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**DE-B- 2 649 042**  
**US-A- 4 041 939**

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## Description

This invention relates to a pedicle screw as disclosed in the first part of claim 1. Such a pedicle screw is disclosed in the EP-A-0242708.

Internal spinal fixation systems are used in the treatment of spinal fractures and to correct spinal deformities. In general such systems involve screws having long shafts, which are inserted into the pedicles and which are then clamped to rods or plates which run roughly parallel to the spine. The screws serve as anchors on the spine and by adjusting the position of the shafts of the screw relative to the rods or plates, the spine, or a section thereof, can be immobilized in the desired configuration.

The manner in which the pedicle screws are attached to the rods has been the subject of much thought and there are a wide variety of clamps and brackets for achieving this end. However, prior proposals have involved devices which are complicated in construction and excessively bulky; so much so that it has been difficult if not impossible to attach the rod/screw assembly to adjacent vertebrae. Moreover, with many devices the rod must be secured to one or more screws before all the screws are inserted. In some devices the rod is threaded making a change of relative position of the rod and the screws awkward.

The present invention provides a pedicle screw which is readily adjustable in a variety of dimensions, which is compact enough to be used on adjacent vertebrae and which can receive rods after the screws have been placed in the spine and permit adjustment.

The solution to the problem is disclosed in the second part of claim 1.

Preferably the clamping means is a block or panel, slidably mounted in the yoke and having screw means for pressing the rod against the cusp or projection. The screw means preferably comprises two screws, one on either side of the cusp or projection so that the rod can be tilted by advancing one screw or the other.

The yoke is preferably provided with grooves and the block has matching grooves which dovetail with the grooves in the yoke allowing the block to slide in the yoke. A socket and a matching projection are preferably provided in the grooves of the yoke and block so that when the block is tightly clamped against a rod inserted in the yoke the block is prevented from sliding in the yoke.

The invention further comprises a spinal fixation assembly comprising a pedicle screw as described, in combination with a rod for insertion in the yoke of the screw.

The invention will be described more fully in connection with the accompanying drawings in which:

Fig. 1 is an exploded perspective view of a spinal fixation assembly using a pedicle screw according to the invention.

Fig. 2 is a side view of a pedicle screw according to the invention.

Fig. 3 is an end view of the screw of Fig. 2.

Fig. 4 is a view in side elevation showing details of the block shown in Figs. 1, 2 and 3.

Fig. 5 is an end view of the block of Fig. 4 showing the dovetail slot for engagement with the yoke.

Fig. 6 is a schematic posterior view of a portion of a vertebral column showing the use of pedicle screws in spinal fixation assemblies according to the invention.

Referring to the drawings, Fig. 1 shows a screw according to the invention. The screw, indicated generally as 10, comprises a shaft 11 which is threaded at one end as at 12 and preferably somewhat pointed for introduction into the bone. At the opposite end is a yoke or trough 13. The forward end of the yoke is curved as at 14 to receive a rod 15. The rod 15 may be smooth, i.e., unthreaded. As shown more clearly in Figs. 2 and 3, the front inside wall 16 of the yoke is tapered inwardly to form a cusp or projection 17 against which the rod 15 can bear. The side walls 18 of the yoke are provided with grooves or slots 19 having rear undercut portions 20, for receiving a panel or block 21. As shown in Figs. 4 and 5, the block 21 has lands 29 with matching undercut portions 26 which form a dovetail joint with the undercut portions of the yoke.

The block 21 is provided with two set screws 22 and 23 which, as shown in Fig. 3, can be advanced through the block to contact the rod 15, pressing it against the cusp 17 formed in the forward inner surface of the yoke. The outer ends of the set screws 22, 23 may be given hexagonal heads so that they may be operated by a suitable wrench. The thickness of the block 21 is considerably less than the depth of the yoke 19, so that it will fit loosely in the yoke. However, when the screws 22, 23 are advanced to bear against an inserted rod, as shown in Fig. 3, the block is forced back so that the undercut portions 26 of the lands 29 engage the undercut portions 20 of the yoke.

The interior of the undercut portions 20 of the slots 19 may be provided with a small projection 24 (Figs. 2 and 3) and a matching socket 25 is provided in the block 21 so that when the screws 22, 23 are advanced and press against a rod, forcing the block back against the rear part of the slots 19, the projections 24 will seat in sockets 25 preventing sliding of the block in the socket.

In use the screw may be inserted into the pedicle using Kirschner wires to provide guide holes according to conventional teaching. Sockets 30 may be provided in the side walls of the screw yoke for aid in manipulating the screw. After two or more of the screws have been positioned at the points desired, a rod may be inserted through the open rear ends of the yokes of the screws. The blocks 21 are then dropped into the slots 19 and the set screws 22, 23 tightened. Since the contact between the rod and the inside of

the yoke is at the cusp 17, by advancing one screw or the other the rod may be tilted relative to the screws. This may be used, inter alia, to bring the spine itself to a desired alignment, to correct spinal deformities.

Fig. 6 shows a sequence of thoracic vertebrae to which two fixation rods using pedicle screws according to the invention have been applied. The lateral dimensions of the yoke end of the screw may be quite small; on the order of 12 x 12 mm, for example. It is therefore possible, as shown in Fig. 6, to insert screws according to the invention in adjacent vertebrae 27, 28 without interference. Moreover, because the angle between the screw and rod can be adjusted by balancing the two set screws it is possible to adjust the angle of the rod after it is in position with great ease.

#### Claims

1. Pedicle screw (10) with a shaft (11) having a forward end (12), a rear end (13) and a longitudinal axis, said forward end (12) being threaded for insertion into a bone and said rear end (13) being shaped to form a yoke for receiving a rod (15) running transversely to said longitudinal axis, the pedicle screw further having removable clamping means (21) for clamping a rod (15) inserted in said yoke against said yoke, characterized in that, said shaft (11) is made of one piece, and that said clamping means (21) is insertable in said yoke closing said yoke in an axial direction of the shaft and clamping said rod (15) radially in the direction of said longitudinal axis.
2. Pedicle screw according to claim 1, characterized in that the bottom wall (14) of said yoke (13) has a curved shape adapted to receive said rod (15).
3. Pedicle screw according to claim 1 or 2, characterized in that said bottom wall (14) of said yoke (13) has an inwardly extending projection or cusp (17) for contacting said rod (15) inserted in said yoke (13).
4. Pedicle screw according to one of the claims 1-3, characterized in that said removable clamping means (21) is a block with means (29) for slidingly mounting said block in said yoke (13) and means (22, 23), preferably screws, for clamping said rod (15) inserted in said yoke (13).
5. Pedicle screw according to claim 4, characterized in that said yoke (13) comprises grooves (19) in the side walls (18) of said yoke (13) and that said block (21) has lands (29) matching said grooves (19).
6. Pedicle screw according to claim 5, characterized in that said grooves (19) in said yoke (13) and said lands (29) in said block (21) have undercut portions (26) which dovetail with one another.
7. Pedicle screw according to claim 6, characterized in that means (24, 25) are provided in said undercut portions (26) for suppressing relative movement between said block (21) and said yoke (13).

8. Pedicle screw according to one of the claims 3 to 7, characterized in that said means (22, 23) are two set screws, adapted to be selectively advanced into said yoke (13) on either side of said projection (17) providing adjustability of the angle between said rod (15) and said longitudinal axis of said shaft (11).

9. Spinal fixation assembly comprising at least two pedicle screws (10) according to one of the claims 1 to 8 and a rod (15).

10. Spinal fixation assembly according to claim 9, characterized in that the rod (15) is unthreaded.

#### Patentansprüche

1. Pedikelschraube (10) mit einem Schaft (11), welcher ein vorderes Ende (12), ein hinteres Ende (13) und eine Längsachse aufweist, wobei das vordere Ende (12) ein Gewinde zur Einführung in einen Knochen trägt und das hintere Ende (13) als Joch zur Aufnahme einer Stange (15) ausgebildet ist, welche quer zur Längsachse verläuft, wobei die Pedikelschraube weiter eine demontierbare Klemmvorrichtung (21) zum Festklemmen einer in das Joch eingeführten Stange (15) gegen das Joch besitzt, dadurch gekennzeichnet, dass, der Schaft (11) einstückig ausgebildet ist, und dass die Klemmvorrichtung (21) derart in das Joch einführbar ist, dass sie das Joch in axialer Richtung des Schaftes verschliesst und die Stange (15) radial in Richtung der Längsachse festklemmt.
2. Pedikelschraube nach Anspruch 1, dadurch gekennzeichnet, dass der Boden (14) des Joches (13) eine gekrümmte, zur Aufnahme der Stange (15) angepasste Form aufweist.
3. Pedikelschraube nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass der Boden (14) des Joches (13) mit einem sich nach innen erstreckenden Vorsprung oder einer Spitze (17), zur Anlage mit der in das Joch (13) eingeführten Stange (15), versehen ist.
4. Pedikelschraube nach einem der Ansprüche 1-3, dadurch gekennzeichnet, dass die demontierbare Klemmvorrichtung (21) ein Block mit Mitteln (29) zur verschiebbaren Montage des Blockes im Joch (13) und Mitteln (22, 23), vorzugsweise Schrauben, zum Festklemmen der in das Joch (13) eingeführten Stange (15), ist.
5. Pedikelschraube nach Anspruch 4, dadurch gekennzeichnet, dass das Joch (13) Nuten (19) in den Seitenwänden (18) des Joches (13) aufweist und dass der Block (21) mit den Nuten (19) zusammen-

passende Stege (29) aufweist.

6. Pedikelschraube nach Anspruch 5, dadurch gekennzeichnet, dass die Nuten (19) im Joch (13) und die Stege (29) im Block (21) Hinterschneidungen (26) zur gegenseitigen Schwalbenschwanzverbindung aufweisen.

7. Pedikelschraube nach Anspruch 6, dadurch gekennzeichnet, dass Mittel (24, 25) in den Hinterschneidungen (26) vorgesehen sind zur Unterdrückung der Relativbewegung zwischen Block (21) und Joch (13).

8. Pedikelschraube nach einem der Ansprüche 3-7, dadurch gekennzeichnet, dass die Mittel (22, 23) aus zwei Einstellschrauben bestehen, welche derart ausgestaltet sind, dass sie wahlweise auf beiden Seiten des Vorsprungs oder der Spitze (17) in das Joch (13) vorgetrieben werden können um den Winkel zwischen der Stange (15) und der Längsachse des Schaftes (11) anzupassen.

9. Wirbelsäulenfixationsvorrichtung mit mindestens zwei Pedikelschrauben (10) gemäß einem der Ansprüche 1 bis 8 und einer Stange (15).

10. Wirbelsäulenfixationsvorrichtung nach Anspruch 9, dadurch gekennzeichnet, dass die Stange (15) kein Gewinde aufweist.

## Revendications

1. Vis pour pédicule (10) avec une tige (11) comportant une extrémité antérieure (12), une extrémité postérieure (13) et un axe longitudinal, l'extrémité antérieure (12) étant filetée en vue de son insertion ou introduction dans un os et l'extrémité antérieure (13) étant façonnée pour former un étrier destiné à recevoir une barre (15) qui s'étend transversalement par rapport à l'axe longitudinal,

la vis pour pédicule comprenant également un dispositif de serrage amovible (21) destiné à serrer une barre (15) introduite dans l'étrier précité contre l'étrier en question, caractérisée en ce que

la tige (11) est façonnée d'une seule pièce et en ce que

le moyen de serrage (21) peut être inséré dans l'étrier précité de manière à fermer l'étrier en question dans une direction axiale de la tige et à serrer la barre (15) radialement en direction de l'axe longitudinal précité.

2. Vis pour pédicule selon la revendication 1, caractérisée en ce que la paroi de fond (14) de l'étrier (13) a une forme courbée adaptée à recevoir la barre (15).

3. Vis pour pédicule selon la revendication 1 ou 2, caractérisée en ce que la paroi de fond (14) de l'étrier (13) comporte une corne ou saillie qui s'étend vers l'intérieur (17) destinée à venir en contact avec la barre (15) introduite dans l'étrier (13).

4. Vis pour pédicule selon l'une quelconque des revendications 1 à 3, caractérisée en ce que le moyen de serrage amovible (21) est constitué par un bloc avec un dispositif (29) destiné au montage à coulissement du bloc précité dans l'étrier (13) et de dispositifs (22, 23), de préférence des vis, pour serrer la barre (15) introduite dans l'étrier en question (13).

5. Vis pour pédicule selon la revendication 4, caractérisée en ce que l'étrier (13) comprend des rainures ou gorges (19) dans les parois latérales (18) de l'étrier (13) et en ce que le bloc (21) comporte des surfaces (29) qui s'apparient aux gorges ou rainures (19).

6. Vis pour pédicule selon la revendication 5, caractérisée en ce que les rainures ou gorges (19) dans l'étrier (13) et les surfaces (29) du bloc (21) comportent des parties évidées (26) qui s'adaptent les unes aux autres en queue d'aronde.

7. Vis pour pédicule selon la revendication 6, caractérisée en ce que des dispositifs (24, 25) sont prévus dans les parties évidées (26) pour supprimer un mouvement relatif entre le bloc (21) et l'étrier (13).

8. Vis pour pédicule suivant l'une quelconque des revendications 3 à 7, caractérisée en ce que les dispositifs (22, 23) sont constitués par des vis d'ajustement, adaptées à progresser de manière sélective dans l'étrier (13) de chaque côté de la saillie (17) assurant ainsi l'ajustement de l'angle entre la barre (15) et l'axe longitudinal de la tige (11) précitée.

9. Ensemble de fixation de la colonne vertébrale, qui se compose d'au moins deux vis pour pédicule (10) selon l'une quelconque des revendications 1 à 8 et d'une barre (15).

10. Ensemble de fixation de la colonne vertébrale selon la revendication 9, caractérisé en ce que la barre (15) n'est pas filetée.

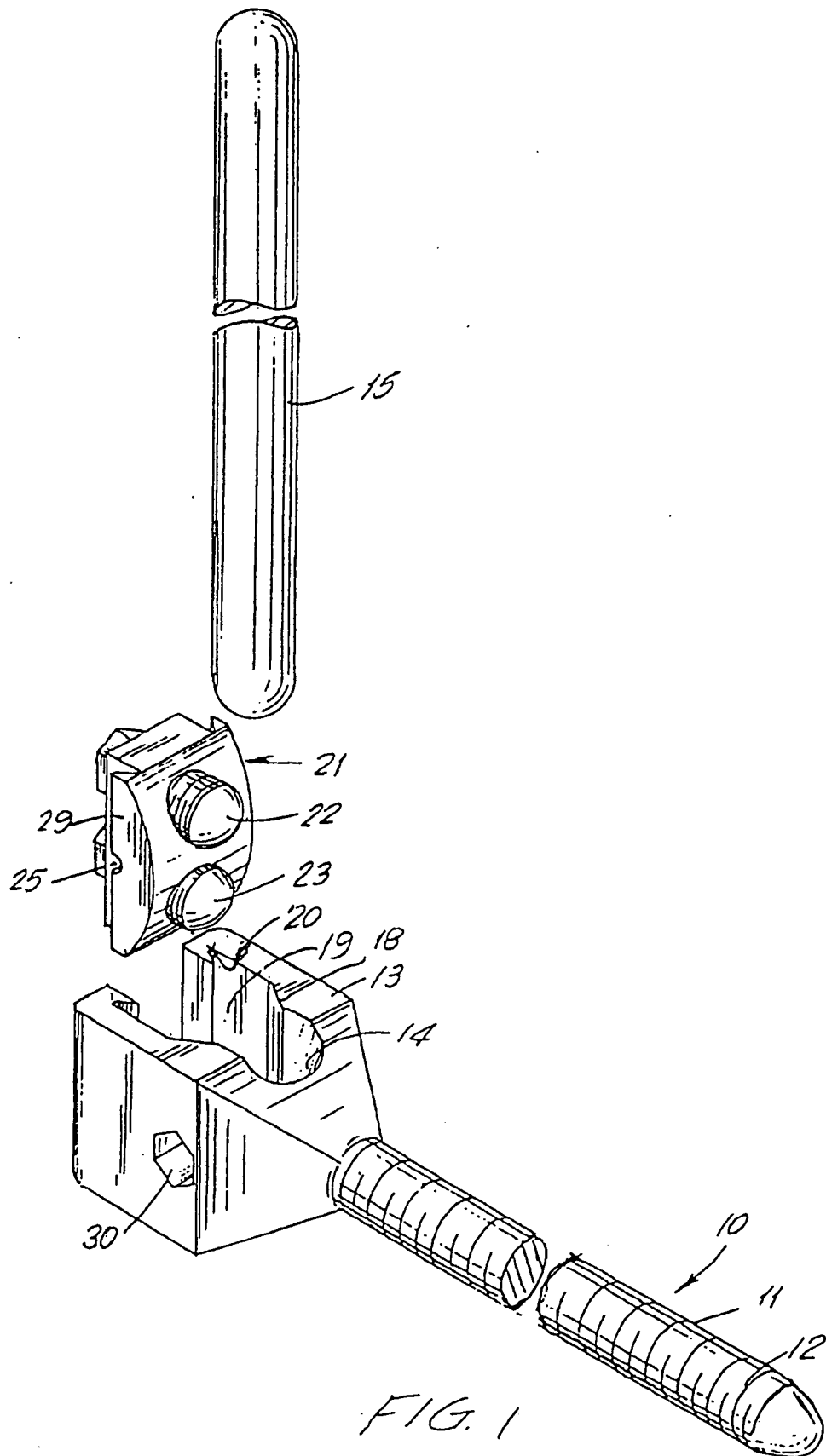


FIG. 1

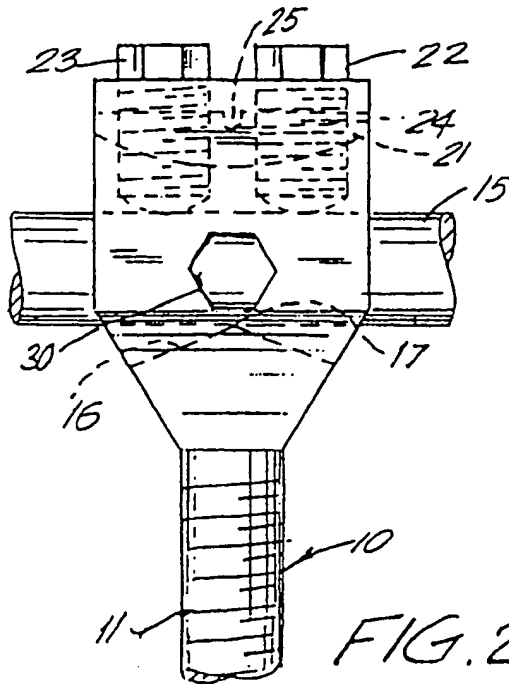


FIG. 2

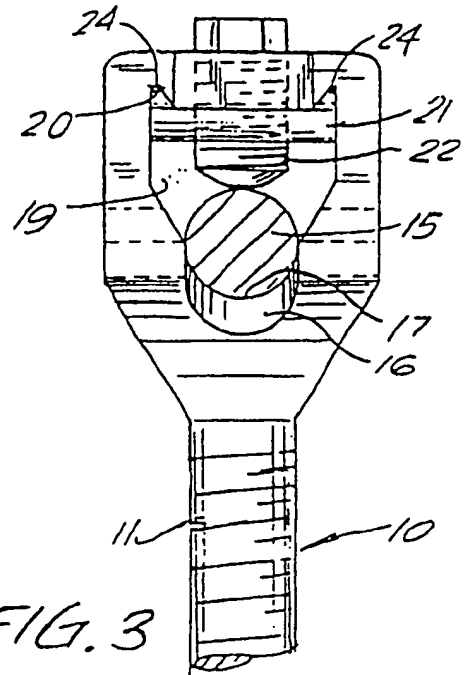


FIG. 3

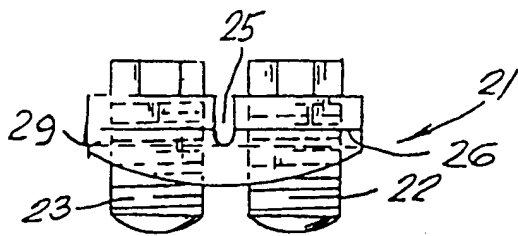


FIG. 4

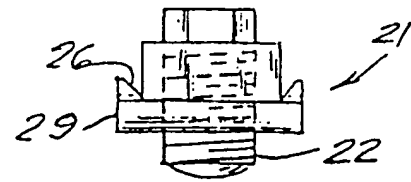


FIG. 5

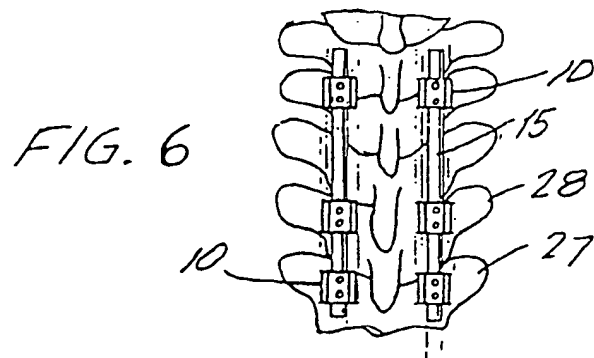


FIG. 6